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BACKGROUND REPORT
FOR ENVIRONMENTAL STUDIES
IN THE TIMMINS AREA

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Ontario Ministry of the Environment
Sudbury, Ontario
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I. Introduction

In May, 1972, Ecstall Mining Company, a wholly-owned subsidiary of Texas Gulf Sulphur is expected to begin operation of an electrolytic zinc plant (smelter and refinery) in the south-east corner of Hoyle Township, about 12 miles northeast of Timmins. The new plant will produce annually, approximately 120,000 tons of refined zinc, 230,000 tons of sulphuric acid and one million pounds of cadmium metal. Because of the possible adverse effects to plant life associated with such a concern, the Phytotoxicology Section of the Air Quality Branch initiated a pre-pollution background investigation as to the state of the vegetation two years prior to the expected commencement of operations at the refinery.

Plot Establishment

During the growing season of 1970, ten surveillance plots and two control plots (50 miles from the potential source) were established by Phytotoxicology personnel in the Timmins area (see map, page 4).

Plot #1 Location: 1 mile northeast of Hoyle on the south side of Highway #101 just west of the junction with Highway #610 in Matheson Township.

Site Description: Trembling aspen woods - Dominant aspen mature to overmature, thinning out naturally with a heavy understory of mountain maple.

Plot #2 Location: 2 miles northeast of Hoyle on the east side of Highway #610 in Matheson Township.

Site Description: Open aspen stand on the edge of a black spruce woods. Trembling aspen is the dominant species with a speckled alder understory, and light ground cover. The soil is shallow, rocky and acidic.

Plot #3 Location: 5 miles northeast of Hoyle on the south side of Highway #610 just east of Matheson Creek in Matheson Township.

Site Description: Open aspen woods with a mixture of trembling aspen, balsam poplar, and speckled alder with a dense ground cover.

Plot #4 Location: 10 miles northeast of Hoyle on the east side of Highway #67 just north of the junction with Highway #610 in Dundonald Township.

Site Description: Open aspen woodlot with trembling aspen dominant and an understory of alder and hazel.

Plot #5 Location: 20 miles northeast of Hoyle north of Highway #67 on the west side of Genest Rd. in Calvert Township.

Site Description: Dense stand of trembling aspen and speckled alder on a thin, damp, rocky, soil.

Plot #6 Location: 5 miles east of Hoyle on the north side of Highway #101 just east of the Frederick House River in Matheson Township.

Site Description: Trembling aspen dominant with a few scattered balsam fir and a ground cover of beaked hazel, mountain maple, with a few scattered speckled alder and pin cherry.

Plot #7 Location: 10 miles east of Hoyle in Kettle Lakes Provincial Park in German Township.

Site Description: Open, dry sandy jack pine woods with aspen-alder mixture.

Plot #8 Location: 20 miles east of Hoyle on the south side of Highway #101, approximately 1.5 miles east of Shillington in Currie Township.

Site Description: Mixed aspen and coniferous woods with many seedlings and saplings and an understory mostly of choke cherry.

Plot #9 Location: 10 miles southwest of Hoyle on the south side of Highway #101 just east of Schumacher in Tisdale Township.

Site Description: Open aspen stand on a rocky slope with a speckled alder and balsam fir understory.

Plot #10 Location: 20 miles southwest of Hoyle on the north side of Highway #101 near the township line between Ogden and Bristol Townships.

Site Description: Damp woods with trembling aspen dominant and mixed with conifers. The main understory species are speckled alder, mountain maple, viburnum and showy mountain ash.

Plot #11 Location: 50 miles southwest of Hoyle on the east side of Highway #144 in Stetham Township.

Site Description: Trembling aspen woods on a fine sandy soil with a beaked hazel and mountain maple understory.

Plot #12 Location: 50 miles east of Hoyle on the south side of Highway #101 in Michaud Township.

Site Description: Mixed aspen, spruce and jack pine woods with an alder understory on a well-drained to dry sandy soil.

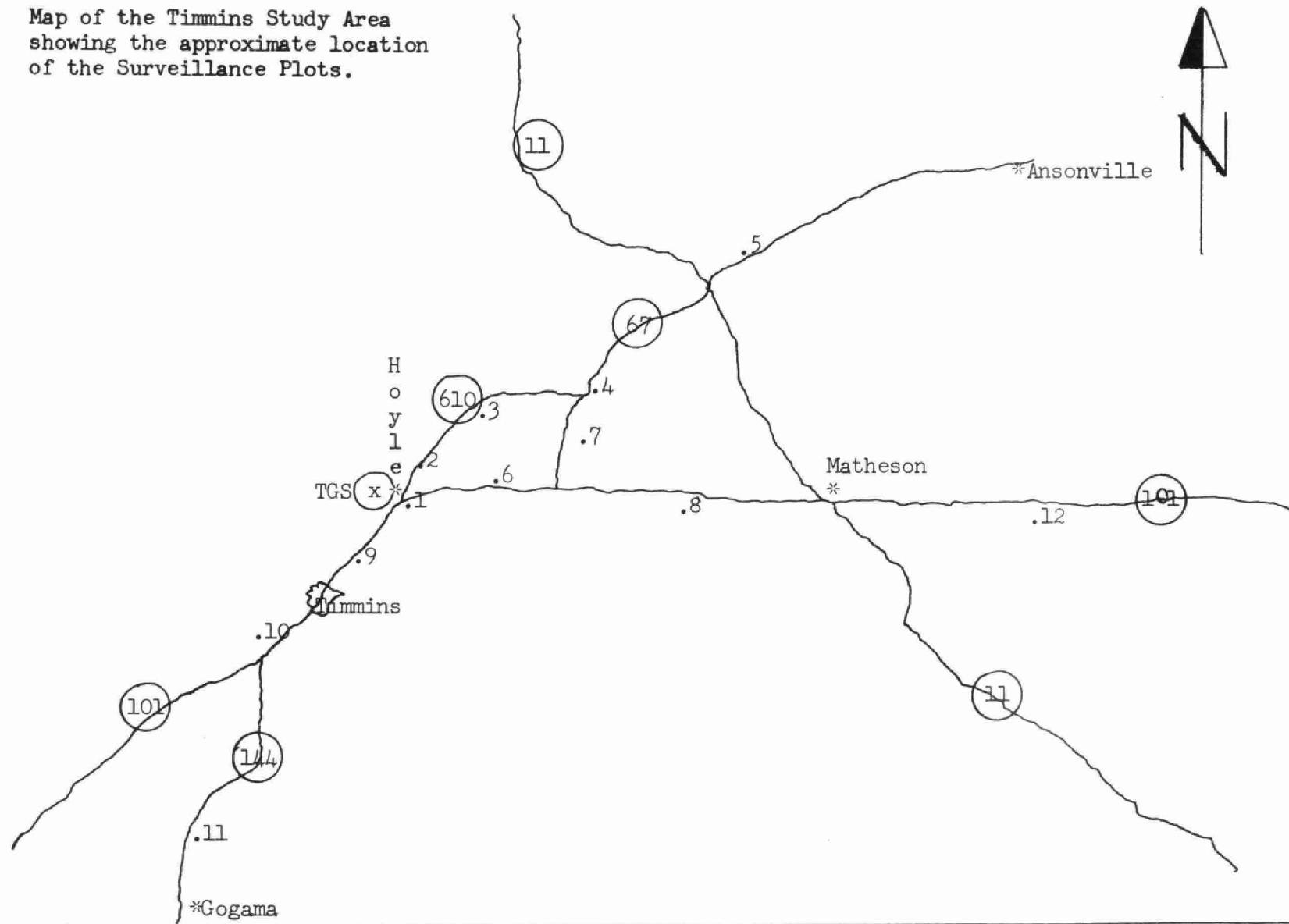
II. Programme Outline

During the 1970 growing season each of these plots was visited only once, since the establishment of such a network was a lengthy project. However, in 1971, all twelve plots were inspected in June, July, August, and September.

At the time of the 1970 visit, 20 trembling aspen trees and 10 shrubs (alder, hazel, mountain maple, or choke cherry) were tagged in a 66 ft. x 66 ft. area at each plot. The "crown condition" of the trees was recorded, along with insect or disease injury, in order to establish a history of the vegetation on the plots. As well, the heights and diameters of the tagged trees were recorded for use in growth studies.

At each plot, two 3.3 ft x 3.3 ft. grids were established and the number and species of each type of plant found on these grids were recorded to determine any future fluctuations in plant populations.

Map of the Timmins Study Area
showing the approximate location
of the Surveillance Plots.



A programme of sampling the vegetation, soil, and water for chemical analysis was initiated in the vicinity of each established plot in 1970. Leaf samples from trembling aspen, white birch, alder (or substitute), white spruce, forage, soil, and water were collected and analyzed for fluoride, total sulphur, sulphate, iron, zinc, cadmium, and arsenic. In 1971, this programme was expanded to include jack pine, white spruce, white birch, trembling aspen, speckled alder, beaked hazel (or substitute), forage, soil, and water which were analyzed for total sulphur, sulphate, silver, arsenic, cadmium, iron, and zinc.

In January, 1971, a lead peroxide candle was set out at each of the vegetation stations and the candles were exchanged regularly throughout the 1971 season.

III. Observations

During the 1970 and 1971 growing seasons the vegetation on the surveillance plots did not change greatly. The "crown conditions" of the tagged trees remained similar for most of the plots. In Plot #1, 1 mile northeast of Hoyle, some of the mature and overmature aspens began to show signs of decline. In Plots 1, 2, 3, and 9, an area 5 miles northeast to 10 miles southwest of Hoyle, extensive feeding by the larval stage of the Large Aspen Tortrix (Choristoneura conflictana (Wlk.)) in June, 1971 thinned-out the crowns of the trembling aspen, however a second burst of foliage in July returned the affected crowns to their previous status. Most of the trees showed favorable increases in their height and diameter growth. In general the trees, shrubs, and ground flora were in a state of good vigor and expanding growth.

From 1970 to 1971 the number of species of plants found in the microflora grids did not vary significantly. For most grids only 1 or 2 plant species were added to or removed from the average population of 15 species per grid. Also the number of plants for each species remained fairly uniform over the two-year period.

The full chemical analysis of the samples collected in 1971 is still in progress at the time of writing this report. However, the 1970 data have been compiled and subjected to statistical analysis. Table 1 shows the results of chemical analysis for soil, water, and each of the plant species sampled at the twelve plots. The analysis of variance (Table 2) shows that, except for cadmium, the values for each station were not

significantly different illustrating that for a given plant species, soil or water sample the amount of each element did not vary significantly from station to station. This is the result which would be expected since at the time of sampling no unnatural factors were affecting the environment in the study area.

TABLE 1
TIMMINS (1970)
Average of Twelve Plots

Sample	Chemical Analysis Results								
	F ppm	ToS %	SO ₄ -S %	SO ₄ -S meq	Fe ppm	Zn ppm	Cd ppm	As ppm	pH
White Birch	0	.18	.10		44	284	.60	0.6	
Trembling Aspen	0	.23	.15		57	231	.48	0.6	
Speckled Alder	.16	.21	.12		54	52	.28	0.7	
White Spruce	0	.09	.07		25	60	.16	0.6	
Forage	0	.16	.11		44	32	.16	0.7	
Soil	307	.06		.24	1.51(%)	75	3	2.6	5.2
Water			(ppb)					(ppb)	
		60			.27	0.1	.012	.02	9
									6.7

TABLE 2
SUMMARY OF ANALYSIS OF VARIANCE (F-VALUES)
FOR DIFFERENT CHEMICALS IN TIMMINS (1970)

Chemical	Total Sulphur	Sulphate- Sulphur	Arsenic	Cadmium	Fluoride	Iron	Zinc
Sources of Variation							
Species	35.0**	13.57**	0.50	23.67**	0	5.35**	6.91**
Stations	1.0	0.14	0.58	3.68*	0	1.79	0.56

* - significant at 5% level
** - significant at 1% level

The table of analysis of variance also shows that for all elements except arsenic and fluoride the differences between the species were significant at the 1% level. It is to be expected that the leaves of one species would contain greater or smaller amounts of a given element than those of another species, however, the mean values for all species and elements in Table I are within the normal range.

Analysis of the lead peroxide candles set out in the Timmins area showed that only background levels of sulphur dioxide were present in the ambient air. The mean values expressed as mg SO₃/100 cm²/day for the period from January to September 1971 are presented in Table 3. It is noteworthy that all of the readings are in the same range and less than 0.10.

TABLE 3
AIR QUALITY SURVEY - TIMMINS
(Jan. to Sept. 1971)

Plot #	Distance and Direction	Mean Value
	from Hoyle	mg SO ₃ /100 cm ² /day
1	1 m. NE	.05
2	2 m. NE	.03
3	5 m. NE	.03
4	10 m. NE	.07
5	20 m. NE	.04
6	5 m. E	.05
7	10 m. E	.04
8	20 m. E	.08
9	10 m. SW	.06
10	20 m. SW	.03
11	50 m. SW	.06
12	50 m. SE	.04

IV. Summary and Conclusions

During 1970 and 1971 the Phytotoxicology Section of the Air Quality Branch initiated a pre-pollution background survey of the environmental situation in the Timmins area where it is expected that Texas Gulf Sulphur will open an electrolytic zinc refinery near Hoyle (12 miles northeast of Timmins) in the spring of 1972.

The information gathered indicates that within a 20 mile radius of the proposed refinery, the condition of vegetation (trees, shrubs, and ground flora) is similar to that existing in the control area (number of plants, number of species, growth rate, crown condition etc.) which is located 50 miles from Hoyle. The vegetation, soil, and water samples collected at the twelve plots contain normal amounts of the elements for which they were analyzed (total sulphur, sulphate, fluoride, arsenic, cadmium, iron, and zinc). The lead peroxide candle survey showed that only background levels of sulphur dioxide were present in the ambient air in the study zone.

All of these data are indicative of a "normal" situation in the Timmins area and will serve as valuable background information for studies in future years to assess the impact of the commencement of operations at the zinc refinery.

The construction plans of the refinery were approved by the Air Quality Branch with the objective of keeping emission rates within the standards set by the Branch in order to prevent adverse effects on vegetation, soil, or water in the vicinity of the refinery.

Close surveillance of the environment in the Timmins area will be continued in the 1972 season to provide the necessary information to evaluate the effect, if any, of the effluents generated by this industrial operation at Hoyle.

V. Acknowledgments

The authors wish to express their thanks to Dr. S.N. Linzon, Chief of the Phytotoxicology Section for his supervision, support, and advice; to the staff of the Department of Lands and Forests in Timmins for their advice on local conditions and technical assistance; to Messrs. A.W. Hill and P.J. Temple for their assistance with the compilation of the vegetation data; to Mr. A.C. Rayner and his staff in the Laboratory Services Section for chemical analysis of the vegetation, soil, water samples, and the lead peroxide candles; to Mr. B. Chai for statistical analysis of the chemical data; and to Mrs. Janet Springer for secretarial assistance. Without the co-ordinated effort of all of these people the presentation of this report would not have been possible.



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TERMINAL STREAM: DUFFIN CREEK